

TECHNICAL INFRASTRUCTURE AND TOOLS FOR GAMIFICATION IN EDUCATION

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Abstract: The academic research examines the incorporation of gamification in the context of higher education, with a focus on its importance, factors to consider during implementation, and the impact of Information and Communication Technology (ICT) platforms on improving the educational process. The utilization of game components and concepts in non-game contexts, sometimes referred to as gamification, is a potentially effective strategy for fostering student engagement and motivation within the contemporary higher education environment. The initial segment of the paper examines the significance of gamification within the context of higher education, emphasizing its capacity to facilitate active learning, enhance student engagement, and optimize information retention. Acknowledging the necessity for a clear methodology, this study underscores the significance of careful planning, congruence with educational goals, and transparent articulation of anticipated outcomes in order to optimize the advantages derived from gamified educational encounters. The subsequent section examines the essential factors to be taken into account while implementing gamification, including but not limited to mobile compatibility, data security and privacy, analytics, and technical assistance. These characteristics are crucial in guaranteeing the achievement and long-term viability of gamification projects in educational institutions. A comprehensive examination of notable information and communication technology (ICT) platforms utilized for gamification purposes is performed, specifically emphasizing "Classcraft," a gamification platform designed specifically for educational contexts. Classcraft offers a range of customized features, real-time tracking capabilities, and seamless connection with learning management systems, rendering it an appealing tool for instructors seeking to establish immersive and captivating learning environments. The available research indicates that the utilization of Classcraft has a beneficial effect on student involvement, motivation, and academic achievement. In summary, the strategic incorporation of gamification inside information and communication technology (ICT) platforms such as Classcraft holds the promise of revolutionizing higher education through the enhancement of dynamic and engaging learning experiences. The optimal utilization and strict adherence to established guidelines are crucial in order to fully leverage the educational benefits of gamification, hence augmenting the overall standard of education in the era of digital advancements.

Keywords: Gamification, ICT Platforms, ICT Tools, Technical infrastructure

Field: Social sciences

1. INTRODUCTION

The domain of education has undergone a process of development, and in the era of digital advancements, the rate of this transformation has experienced a significant surge. The core of this transformation is in the incorporation of technology into learning methodologies, resulting in a reconfiguration of the conventional boundaries of educational settings. Two major trends that have evolved during the digital revolution are gamification and Learning Management Systems (LMS). According to Deterding et al., (2011), gamification refers to the utilization of game mechanics and game thinking in contexts outside of gaming in order to enhance user engagement and accomplish certain objectives. In essence, gamification leverages the inherent motivations of humans to address challenges, advance through various stages, and attain incentives, hence offering a dynamic and captivating approach to acquiring knowledge and integrating information (Caponetto et al., 2014). On the other hand, Learning Management Systems (LMS) refer to software systems that offer a structured platform for the administration, delivery, and monitoring of the online learning journey (Weller, 2007). These platforms provide a well-organized setting in which educators can collect educational materials, administer assessments, track student advancement, and foster interactive dialogues. As a result, they effectively bridge the divide between conventional and digital approaches to education.

The integration of gamification and learning management systems (LMS) holds great significance due to its collective capacity to augment the educational experience. Research has indicated that the implementation of gamified learning has been associated with heightened levels of student motivation, increased engagement, improved retention rates, and enhanced problem-solving abilities (Hamari et al., 2014; Anderson et al., 2014). In the realm of education, the Learning Management System (LMS) serves as a tool that enhances the management, documenting, tracking, and distribution of educational materials. This technology enables the learning process to become more efficient and flexible, according to the different needs of students (Watson & Watson, 2007). In light of the significant influence exerted by gamification and learning management systems (LMS) in modern education, it is imperative to conduct a more comprehensive examination of their capabilities, comprehend their collaborative potential, and investigate their prospects for forthcoming educational frameworks. The objective of this study is to conduct a thorough analysis of these two occurrences, emphasizing their importance in influencing the modern educational environment.

2. LITERATURE REVIEW

As a system, gamification is based on information and digital technologies for successful implementation. To successfully implement gamification, several technical requirements should be considered. It must be noted that the technical infrastructure required varies according to each individual gamification implementation, according to its specific characteristics and requirements. However, several key technical requirements for gamification verification in higher education can be singled out:

- **Learning Management System (LMS)** - Such systems represent the basis for modern implementation of learning in traditional conditions, as well as distance learning. It is a platform used by teaching staff and students for multiple purposes. Learning management systems are the basis for implementing gamification, which can be integrated directly into them if the tools support it, or as an independent part that will support the learning management system. Some of the platform's capabilities include (Chahal, 2021):
 - Materials for learning and mastering the subject, in the form of textbooks and presentations
 - Quizzes available for students to test their knowledge
 - Methods for monitoring students' lecture attendance and activity level
 - Notifications to students through the platform and other channels (email)
 - Possibility of uploading documents by the students
 - Possibility of direct communication with teaching staff through a messaging system
 - Tools for collaboration between students (group activities, forums and other elements)
 - Simple text editors for direct work in documents
- **Gamification platforms and tools** - A gamification platform is a software application that provides digital support for system implementation. It includes features such as points, badges, leaderboards, progress bars and challenges. The gamification platform should be able to integrate with learning management systems and offer customization options. In implementing a gamification system, it is necessary to choose an appropriate gamification platform. Implementations without gamification platforms or digital tools will face difficulties in out-of-class activities, as teaching staff will not have control or visibility of them.

- **Hardware requirements** – from the aspect of gamification, each implementation in the educational system will be unique and thus the hardware requirements will vary in different situations. On the one hand, the use of mobile devices (smartphones) nowadays makes implementation easier, as most platforms and digital tools for gamification are compatible and have their own specialized mobile versions. However, the minimum hardware requirements for the implementation of a gamification system in educational institutions can be singled out:
 - A computer system (desktop/laptop) with an installed Windows or Mac OS operating system, which has support for using a web browser with HTML5 technology, available to teaching staff. The computer system will be used to demonstrate the gamification system to students and introduce them to it during class activities
 - A compatible projector in the study rooms, where information can be presented to students
 - Internet connection – it is a wired or wireless Internet connection that is available to the teaching staff for the presentation of the system, as well as a wireless (Wi-Fi) network available to the students, who will access the system through their mobile devices
- **Mobile Compatibility** - With the increasing use of mobile devices, gamification systems need to be compatible with mobile devices to allow students to access the system from anywhere at any time.
- **Security and privacy** - Gamification systems must be secure and protect student data from unauthorized access. It should be in compliance with privacy laws and regulations, such as GDPR and CCPA
- **Analytics and Reporting** - Analytics and reporting tools provide insight into student performance, engagement and progress. These tools can help instructors identify areas where students struggle and tailor the gamification system to better meet their needs.
- **Technical support** – the last segment refers to the support of the IT department/administrator during the design and implementation of the gamification. Since we are talking about digital platforms and tools that will be integrated into existing learning management systems, the support of the IT sector in the educational institution is crucial for a successful implementation. If the educational institution does not have an IT department or it is not involved in planning and supporting the implementation, then there is a probability that the system will not function optimally and will stop working in the short or long term. The support from the IT sector does not only refer to the technical implementation, but also to the full training of the teaching and administrative staff who will manage the system, as well as training as needed to the students who would be participants in it.

The implementation of gamification in higher education requires a combination of prerequisites at the level of organization, system design, user experience and fulfilment of technical requirements. By meeting these requirements, gamification can provide an engaging and effective learning experience for students.

3. ICT TOOLS AND PLATFORMS FOR GAMIFICATION

Since the emergence of gamification in the modern business world in 2009, tools and platforms are simultaneously emerging that are available for use by organizations in their implementations. It must be noted that ICT tools are not mandatory for the implementation of gamification, but as can be seen from previous research, in theory and in practice they are fully recommended for use. A distinction needs to be made between ICT platforms and ICT tools available for gamification. Although they have some common features, they also have many differences.

According to ITU (2012), an ICT platform is a set of related technologies that serve as building blocks for the creation, implementation and administration of a particular service or application. ICT platforms often include hardware and software elements that are designed to work together and give users access to different services or applications through a single interface. On the other hand, ICT tools are unique pieces of software or hardware that are created to perform a specific task or set of tasks. They represent a hardware or software product that is designed to offer a specific function or collection of functions for the creation, storage, processing, or delivery of digital information. ICT tools are often stand-alone solutions that can be used alone or in combination with other platforms or tools. For example, ICT products that enable users to produce, distribute and store documents and data include Microsoft Office, Google Suite and Dropbox.

The key differences between ICT tools and platforms, in terms of gamification, can be found in the following aspects:

- ICT platforms are more comprehensive and offer a variety of services and applications, while ICT tools are more narrowly focused and made to perform specific tasks.

- While ICT tools can be stand-alone items or integrated with other tools or platforms, ICT platforms often consist of numerous integrated tools and operate exclusively on their own, with minimal integrations with other tools or platforms.
- While ICT tools are less complicated and require less investment, ICT platforms are often more complex and require large costs in infrastructure, development and management. If the educational institution decides on an ICT platform, then it would take more time to implement it, and further long-term use of it is recommended, because the change creates a requirement for completely new implementations of the system from the very beginning.
- The choice of ICT tools or platforms to use depends on the needs of the organization, the set goals and strategies for the gamification system, as well as the characteristics of the participants. The choice depends on individual implementations, whereby even for educational institutions of the same rank and area, different ICT tools and ICT platforms can be set up according to needs.

3.1 ICT tools for gamification

Unlike gamification platforms, ICT tools offer selective access to certain components that are applicable in different scenarios. There are a number of tools related to the implementation of gamification in business and education, so the focus is on those that have emerged as relevant in previous research:

- **Habitica** - a habit-building and productivity tool that uses gamification to help users achieve goals and complete activities in a role-playing fashion. More research shows positive effects when implemented in an educational environment, with which students get more freedom and a sense of progress when performing activities. (Kootbally & Aitken, 2021; Martí-Parreño, Alonso-Fernández, & Fernández-Manzano, 2019)
- **Breakout EDU** - A physical game-based learning tool that challenges students to solve puzzles and overcome obstacles to open a box containing a surprise. Through goal setting, the tool enables greater student motivation and engagement (Kuznekoff & Rose, 2018; Ting et al., 2020)
- **Socrative** – a tool that allows instructors to generate quizzes and in-class activities for students to complete in real time. Implementation is generally based on classroom activities, with potential positive effects in increasing student participation in activities (Banfield & Wilkins, 2014; Orhan & Tosuncuoglu, 2016).
- **Minecraft Education Edition** - A game-based learning tool that allows students to collaborate and explore concepts in a virtual world. The connection to an existing video game allows recognition and identification by students, increasing the desire to participate in gamified activities (Kafai & Burke, 2019; Oosterom-Calo, van der Meijden, & Admiraal, 2018)
- **Prodigy** - a math learning tool that uses gamification to help students learn and practice arithmetic concepts through interactive games and rewards (Aydin & Turkoglu, 2019; Schneider et al., 2020)
- **Quizizz** – an online quiz tool that allows instructors to build quizzes with gamification components such as leaderboards, avatars, and medals (Tucker, 2018)
- **ClassDojo** - a classroom management tool that allows teachers to monitor student behavior and progress, as well as communicate with parents. The platform includes a point system that rewards students for good behavior and promotes participation in the classroom (Bolkan, 2018).

3.2 ICT platforms for gamification

Students can learn in an interactive and dynamic environment when gamification is implemented using different ICT platforms. Incorporating ICT platforms into gamification, according to Hanus & Fox (2015), can provide immediate feedback, customized learning and enhance the interaction of learning activities. In addition, the use of ICT platforms can facilitate the creation of game-based scenarios that allow students to experiment and explore in a safe environment. By making learning more engaging and exciting for students, the integration of gamification and ICT platforms can also improve learning outcomes and increase knowledge retention (Kapp, 2012). Following are 4 available ICT learning platforms. It must be noted that the analysis of the platforms is based on the current data available for them, while changes are expected in the near future, according to the development trend and the implementation of gamification.

3.2.1 Popular platforms

In addition to Kahoot! and Classcraft, there are other platforms that have been researched in the past years for their implementation in a gamified system in the education sector.

- Duolingo is a language learning program that engages users through games. Duolingo has been shown to be an excellent language acquisition tool, with some studies indicating that users can make large gains in language proficiency (Shaffer & Vygotsky, 2019).
- Quizlet is a gamification-based online learning platform that helps students study and learn. Quizlet has been proven to be an effective tool for improving student learning and information retention (Carr et al., 2017; Dankbaar et al., 2016)
- 3D GameLab is gamification software created for educational purposes. Several studies have shown that 3D GameLab can be a useful tool for fostering student engagement and motivation.
- CodeCombat is a gamification platform specifically focused on coding that teaches users to code through a series of stages and challenges. CodeCombat has been found to be an excellent platform for teaching coding topics and increasing student engagement (Abuhamdieh et al., 2021)
- DragonBox is a series of math learning games that use gamification to teach concepts like algebra and geometry. Previous research shows that DragonBox is an excellent method for teaching arithmetic topics and increasing student engagement (Steiner & Bos, 2018).
- Edmodo is a gamified learning platform that allows teachers and students to collaborate and engage in a safe online environment. Students can complete homework, quizzes, and surveys and get a quick response from their instructors. Edmodo also allows instructors to gamify their classrooms by offering badges and other rewards for completing activities and demonstrating their skills (Viberg & Gronlund, 2017).
- Nearpod is a platform that allows educators to design and share interactive lessons with their students. The platform integrates gamified components such as quizzes, surveys, and collaboration capabilities to encourage student engagement and learning

3.2.2 Kahoot!

This ICT platform allows users to create and play interactive quizzes, surveys and games. With over 7 million active users and 1.5 billion participating players as of 2021, Kahoot! has become a popular platform for gamification in education and beyond (Yang & Chen, 2020). Founded in 2013, Kahoot! has developed various features that make it an adaptable platform for gamification in education, training and events. A core element of Kahoot! presents its easy implementation, with a simple user interface that allows anyone without technical knowledge to develop a gamified system. Kahoot! allows users to assign games as homework, allowing students to practice and reinforce their learning outside of the classroom. In addition to analytics and reporting capabilities, Kahoot! allows instructors and trainers to track student progress and identify areas for growth. Multiple players can engage in real-time gameplay to accomplish collaboratively gamified activities and goals. This feature made Kahoot! a popular tool for team building and group learning.

The main tools that Kahoot! offers for gamification in education are:

- **Quiz Creation** - Allows users to design quizzes using multiple choice, open-ended and true/false questions.
- **Question Personalization** - Allows gamified system designers to add engaging photos and videos to their questions.
- **Real-time co-op mode** - allows many players to participate in a real-time game, with a leaderboard showing their ranking.
- **Homework options and activities** - allows instructors to assign games as homework, allowing students to practice and reinforce their knowledge outside of the classroom.
- **Analytics and reports** – offers faculty analytics and reporting capabilities, allowing them to analyze student progress and identify areas for improvement.
- **Collaboration** - allows users to develop and edit games in collaboration with others.
- **Gamified Activity Templates** - Provides a collection of pre-made, modified gamified activities on a variety of topics.
- **Mobile App** - allows users mobile access to Kahoot! games and features.

Kahoot! is a comprehensive platform for gamification in education, training and events due to its extensive feature set. Its ease of use, versatility, and potential for student motivation make it a popular platform for generating interactive learning experiences in a gamified system in higher education. Academic research to date shows that Kahoot! can be an effective platform to promote student engagement, motivation and learning outcomes in various educational settings (Collier & Birch., 2018). However, the researchers also note the importance of using Kahoot! in appropriate ways that align with educational goals and pedagogical principles (Yang & Chen, 2020). Overall, research suggests that Kahoot! has the potential to be a valuable platform for gamification in education, but that its effectiveness depends on how it is used and integrated into the curriculum.

3.2.3 Classcraft

Classcraft represents a gamification platform fully focused on education, aiming to provide a dynamic and attractive learning environment, created in 2013. The platform uses gamification principles to motivate and engage students in their learning, allowing them to build their own avatars and embark on a journey where they earn points, level up and acquire abilities by completing academic activities, engaging in class and displaying positive behavior. Classcraft has approximately 11 million registered users worldwide as of 2022. Used in thousands of schools in 75 countries, including the US, Canada, the UK and Australia, use Classcraft. This platform has been awarded several accolades, including the 2019 SIIA CODiE Award for Best Game-Based Education Solution. In a survey conducted by Classcraft in 2021, 89% of educators claimed that Classcraft improved their classroom management, and 84% said it improved student motivation and engagement.

Classcraft's extensive customization capabilities are one of its primary benefits, allowing educators to establish their own rules and incentives, connect the game to their curriculum, and personalize the experience for their students. Through the platform, teachers can monitor student progress and behavior, communicate with students and parents, and provide real-time feedback. Classcraft has evolved over the years, introducing additional features such as narrative elements, real-time virtual communication capability, and integration with popular learning management systems such as Google Classroom and Schoology.

The primary features of Classcraft are:

- **Class and Classroom Management** - Allows teachers to manage their classroom, including creating classes, adding students, and creating unique rules and rewards.
- **Virtual avatars** - students can construct their own avatars to represent themselves in the game.
- **Mission-based narrative** - offers an overall narrative that connects all learning activities and in-game stimuli, thereby increasing student engagement.
- **Academic Tasks** - Students can earn points and rewards by completing academic tasks such as successfully answering questions, engaging in class and completing homework.
- **Random Events** - adds unpredictability and excitement to the game by introducing random events that can help or hinder students' progress.
- **Social interaction** - Enables collaboration and communication between students, as well as the ability to join teams and support each other in the game.
- **User interface for teaching staff** - Provides a real-time overview of student achievement and behavior, allowing teachers to provide feedback and intervene as needed.

A number of researchers have found that Classcraft can be an effective tool for fostering student engagement, motivation, and collaboration in the classroom. A study conducted by Jean-Michel Disch et al., (2019) found that students who used Classcraft over an academic year were more motivated and earned higher grades than those who did not. Similarly, a 2018 study found that using Classcraft increased student participation. Classcraft can have a beneficial effect on student learning outcomes and can be a useful tool for instructors aiming to increase student engagement and motivation (Colaric et al., 2019).

5. CONCLUSIONS

The digital era has brought about significant changes to the educational sector, resulting in the implementation of novel approaches aimed at improving the overall learning process. The combination of gamification and Learning Management Systems (LMS) is a key aspect of this shift, since it presents exciting opportunities for enhancing current pedagogical practices. The implementation of gamification acts as a catalyst for facilitating immersive learning experiences, hence fostering an educational atmosphere where students actively engage as stakeholders in their academic pursuits. The analysis encompasses a range of unique platforms, such as Kahoot! and ClassDojo, which highlight the versatility of gamification in different pedagogical frameworks. These technologies have the ability to enhance student engagement and retention, while also cultivating a comprehensive learning environment that promotes critical thinking, cooperation, and creativity. In contrast, Learning Management Systems (LMS), exemplified by platforms such as Edmodo and Nearpod, enable the smooth incorporation of gamified materials into conventional educational approaches. Educational institutions are equipped with the necessary infrastructure to facilitate the delivery, monitoring, and customization of information in accordance with the specific requirements of their students. This ensures a balanced integration of conventional and digital teaching methods.

It is important to acknowledge the limitations of this study. The main limitation is the platforms evaluated, which, despite their diversity, do not encompass all the numerous tools accessible on the market. Moreover, although the advantages of gamification and learning management systems (LMS) have been emphasized, it is crucial to delve into potential obstacles such as accessibility concerns, technical inequalities, and the risk of over dependence on

digital approaches. Future study should aim to address these gaps by expanding the range of platforms examined, doing more in-depth investigations into the potential drawbacks of gamification and learning management systems (LMS), and examining their lasting effects on student achievements. Furthermore, it is imperative to do research on the versatility of these tools in various educational systems and cultural contexts to guarantee their worldwide applicability.

In conclusion, the combination of gamification and learning management systems (LMS) represents a notable advancement in the progression of contemporary education. However, it is crucial to approach their integration with careful consideration, ensuring that educational goals and the comprehensive growth of students remain the primary focus.

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